ENGINEER CAREER DAY
FEBRUARY 2004

SCHEDULE OF EVENTS

8:30 – 9:00	Registration/Mix with Exhibitors (Breakfast Provided)
9:00-10:00	First Problem, including introduction of judges
10:00 – 11:00	Design/Build Problem
11:00 – 12:00	Dream Date with an Engineer (Who needs J-Lo or Ben Affleck anyway?) (Lunch Provided)
12:00 – 1:00	Testing of Design/Build Project
1:00 – 1:15	Assemble at MOSH
1:45 – 2:00	Presentations by Col. Carpenter and Gary Dahlke, NASA
2:00 –2:15	Presentation of the “ENGINEERING CAREER DAY CUP”
2:15	DISMISSAL

NATIONAL ENGINEERS WEEK
FEBRUARY 22-28, 2004

Competition Problem Statement

REAL LIFE APPLICATION:

Downtown Jacksonville suddenly has a shortage of water and they need it fast! Lucky for Jacksonville, a groundwater reservoir exists; however, the water is far away and very polluted. A group of civil engineers have recently built a water tower that is 120 ft high. It has a capacity of 200,000 gallons. With a place to store the water, all Jacksonville needs now is a team of hydraulic and environmental engineers to find a way to get the water and clean it for the city's use; and you are just the team to do it. Jacksonville needs your help!!

WHAT THE TEAM NEEDS TO DO:

Find a container that can hold at least 2 L of fluid (ex: soda bottle, large food can, etc.) to be used for your groundwater reservoir and a 2 L plastic bottle to be your water tower. The bottom of your water tower reservoir will stand 28" above the ground surface (the floor). The groundwater reservoir can be no taller than 15" high from the ground surface (the floor). You need to find a way to move the water from the groundwater reservoir to the water tower.

The 28" high water tower stands (a standard 3'X5' table) will be provided on the day of the competition; however, you may want to build your own stand or find something that meets the height requirements to practice with. A drawing of the set up is provided. Due to the diversity of your designs, you will be responsible for making sure your containers stand on their own without spilling any water. This may mean building supports of some kind - you decide! Also, there will be no power supply outlets available.

On the competition day we will provide 2 L of polluted water to fill your groundwater reservoir. Part of this problem is to find a way to clean this water by whatever efficient means you find possible so, once the water is in the tower, it is ready for the city's use (no cleaning processes can take place in the water tower). This pollutant will be a substance made of 100 mL of clay /1 Liter of water.

There are no restrictions on what can be done to the flow of water between the groundwater reservoir and the water tower. For example, the water can be pumped to intermediate stations, which have no height restrictions. There are no restrictions to your design other than what has been mentioned. Additional supplies that you may need (tape, additional stands, rubber bands, supports, etc) must be brought with you; this includes any additional water required for set-up (water can be obtained here; however, you will need a container).

GOOD LUCK!

Details of the competition:

- 30 teams – one team from each school. Each team has no more than 4 team members.

- 30 water tower stands (standard 3'X 5' table that are 28" high) will be provided -- one for each team.

- All teams will set up their systems at the same time, but everyone will not run their system at the same time. There will be 3 teams assigned to a judge who will judge each team individually, one at a time. There will be a total of 10 judges for all 30 teams. Each team will have 15 minutes to set-up and a maximum time of 15 minutes to pump their water.

- Judging will be based on the following:

    - Ability to get 2 L of water to the tower in the shortest amount of time
    - Cleanliness of the water
    - Efficiency – considering practicality (ex. The more pumps needed, the more maintenance and thus higher cost, however, your system may run faster!)
    - Creativity / Communication of system to judges

NOTE: Your team will be disqualified if your system leaks.

The Point System:

Each team will start out with a full score of 100 and points will be deducted for the following:

Technical Categories

1. Criteria: Basic Function

Not able to pump the full 2 L in the 15 min time limit: - 15 points

2. Criteria: Environmental

No Removal of Clay	- 30 points
Partial removal of clay	- 5 points
Full Removal of Clay	- 0 points

3. Criteria: Efficiency up to – 30 points

4. Criteria: Speed

Fastest team will get points added + 15 points

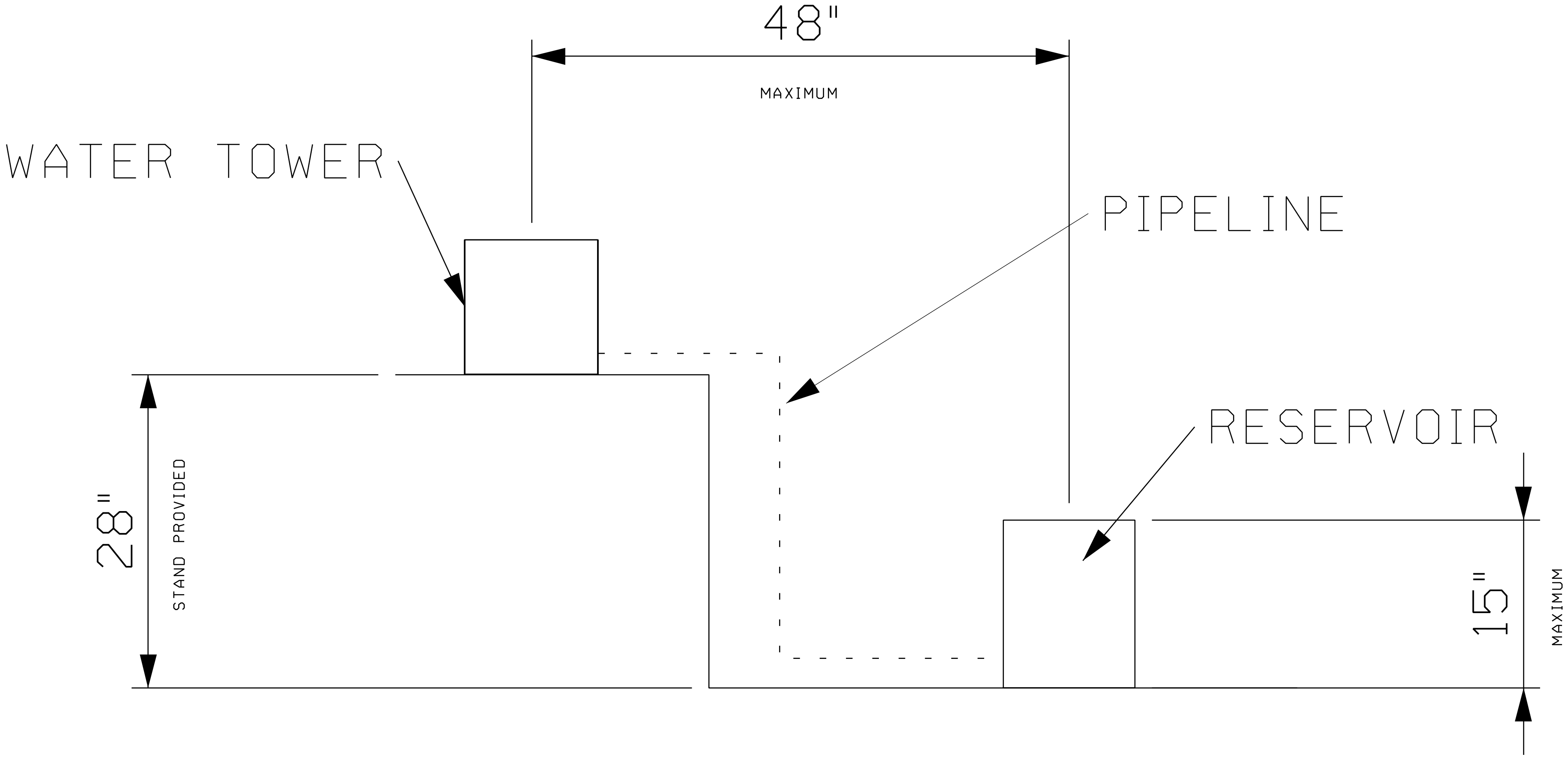
Creativity and Communications

5. Criteria: Creativity

Subjective creativity + 10 points

6. Criteria: Good Communication

Good communication to judge about the system + 5 points



PROBLEM SETUP

1. PROVIDE PUMPS, VALVES, FILTERS, AND OTHER MATERIALS AS NECESSARY FOR OPERATION AS DESIGNED.
2. WATER TOWER TO HAVE MINIMUM CAPACITY OF 2 LITERS
3. STAND FOR WATER TOWER TO BE PROVIDED BY E-DAY FACILITATORS
4. BOTH TOWERS AND RESERVOIR TO BE PLACED ON FLAT SURFACES.

ENGINEERING CAREER DAY FEBRUARY 27, 2004

QUESTIONS Part I

Engineers of most disciplines - Civil, Mechanical, Structural, Electrical, and Chemical - have to work with water in various capacities.

Most calculations in science, including engineering, involve expressing/describing substances – solids, liquids, and gases – by a ratio of weight/mass to a dimension – linear (length), area, and volume.

A student might first use these ratio expressions in a high school chemistry or physics class (if not there definitely later in a college level chemistry or physics course) to determine various quantities such as density- grams per cubic centimeter, pressure –weight per surface area, etc.

These expressions are also used in “conversions” from one unit of measurement to another such as gallons to cubic feet, second to minutes, feet to inches, etc.

Time to get your feet wet; these questions are related to a "5 Gallon Bucket".

For questions requiring calculations round your answers to the first decimal place. For example the numbers 63.45 & 73.62 would be rounded to 63.5 & 73.6

1. What are the dimensions of a typical 5 Gallon Bucket?
(tip: use nearest "eighth of an inch" and "tenth of an centimeter")

inside diameter: ________in., ________cm.

inside height: ________in., ________cm.

2. What is the volume for a 5-gallon bucket
based on measured dimensions?
volume:

____cubic feet (cf)

____meters cubed (m^3)

Unit conversion information
It is known that 1.0 foot is equal to 12.0 inches or 1ft = 12 in.

This expression can be written differently (12in / 1ft)= 1 unit of a distance.
Or as (1ft / 12in)= 1 unit of a distance (it is still the same distance).

A cubed container having dimensions of one foot for each the height, the width, and the length can hold one cubic foot (cf) of water. The same container can also hold 7.48 gallons (gal) of water. This can be written as
(7.48gal / 1cf) = 1 unit container of water.

3. What are the metric unit equivalent conversions?
Did you know one liter is one thousandths of a cubic meter?
How is this written?

____

4. According to your measurements how many gallons and/or liters could the bucket hold?

____ gallons

____ liters

5. Did you know water weighs 62.4 pounds per cubic foot! or 9.80 kilo Newtons per meter cubed.
Use the bucket you measured to calculate how much it would weigh if it were full of water?
Neglect the weight of the empty bucket.

____#/cf

____kN/m^3

6. Using a faucet, fully open the valve then measure the time it takes to fill the bucket completely.

______________seconds

7. Convert the seconds into minutes

_________________________min

8. Lets combine these quantities, volume and time, for a flow rate.
Water flow rate is (expressed as *Q*) measured as the volume divided by time.

Given for example it took10 minutes to fill a 5.0 gallon.

Q= 5 gallons / 10 minutes = ½ gallon per minute

What was the flow rate to fill your 5 gallon bucket?

a. ____ (gal/min)

try these

b. ____ (cf/sec)

c. ____ (ltr/min)

d. ____(m^3/sec)

6. For FUN only, what would you call the metric version of the "5 Gallon Bucket"?

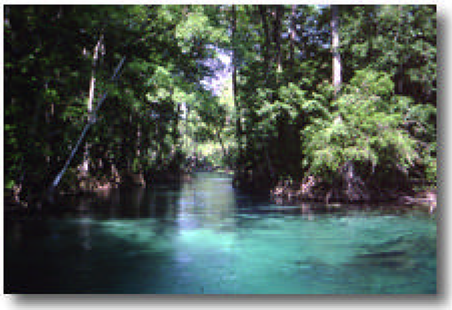
____

End Part I

QUESTIONS

Part II

The following websites were used for the following information.
http://www.dep.state.fl.us/springs/index.htm
http://www.dep.state.fl.us/springs/locator/Spgsmap03.htm
http://tfn.net/Springs/



Silver Springs / Silver River

Spring Description

The spring forms a large semicircular basin 250 feet across. This massive cavern entrance is about 35 feet deep, 125 feet across, 6 feet high, and has a strong flow. The spring creates the Silver River, which flows about 6 miles to the Oklawaha River. Silver Springs is often called the largest freshwater spring in Florida if not in the U.S., with an average flow of 820 cfs or about 530 MGD. However, as noted in both the 1947 and 1977 editions of *Springs of Florida*, only about half of this total is from the main spring vent at the headwaters of Silver River. The rest of the flow is from other springs as far as 3,500 feet below the headspring (Rosenau et al., 1977, pp. 276-79). Therefore, the total flow from the main spring at Silver Springs is probably more like 400-500 cfs. These various vents have water with different temperatures, which means the waters come from different depths or directions and are, in essence, different springs.

Silver Spring is categorized as a first magnitude spring, which has a flow equal to or greater than 100cfs.

For these calculations round your answers to a whole number. For example the numbers 63.45 & 73.62 would be rounded to 64.0 & 74.0

1. Using the 500 cfs determine:

a. How many **5 gallon buckets** would flow **per hour**?

b. How many **gallons** would flow **per day** (expressed in MGD or **M**illion **G**allons per **D**ay)?

QUESTIONS

2. The Corps of Engineers has recently completed construction on a pump station in Palm Beach County, Florida to pump water into a 6,000-acre storm water treatment area (STA). The STA was designed to treat agricultural drainage and provide additional water to the Everglades through release into Water Conservation Area – 1 (WCA-1).

Pump Station 319 – Filling East Distribution Cell

The pump station has three (3) 960 cubic feet per second (cfs) pumps and two (2) 550 cfs pumps.

Question: If all five pumps are running:

a. How many ***5-gallon buckets*** can be pumped ***per hour***?

b. How many **gallons** can be pumped **per day** (expressed in MGD or **M**illion **G**allons per **D**ay)?